APPARATUS AND METHOD FOR DISPENSING PRODUCTS

FIELD OF THE INVENTION

The present invention relates to product dispensers. The present invention also relates to the use of a product dispenser to dispense a product.

BACKGROUND OF THE INVENTION

Liquid products, such as liquid cleaning products, are used throughout residential and commercial properties in a variety of applications. Although liquid products have tremendous utility, liquid products have a number of shortcomings. One primary shortcoming is the bulkiness and weight of liquid products. Packaged liquid products are usually either made relatively small to keep the weight low, or made relatively large causing an undesirable increase in product weight.

Solid products are generally more convenient, safe and economical than liquid products because they do not spill or splash, have reduced manufacturing and distribution costs, and require less storage space. However, solid products must first be converted to a liquid before they can be used in most applications. Generally, a dispenser uses water to dissolve the solid product and stores the resulting liquid "use" solution prior to being pumped into a vessel to be cleaned.

There is a need in the art for a product dispensing apparatus for preparing liquid products for use in residential, commercial, and industrial applications, as well as, an improved method of preparing liquid products for use in residential, commercial, and industrial applications.

SUMMARY OF THE INVENTION

The present invention addresses some of the difficulties and problems discussed above by the discovery of a product dispensing

system, and methods of using the product dispensing system. The product dispenser of the present invention may be used to prepare a liquid solution, such as a cleaning, sanitizing or rinse aid solution, having a desired concentration of active ingredients. The liquid solution is prepared from a solid product, which dissolves to produce a liquid solution having a desired concentration of solid product dispersed therein.

Accordingly, the present invention is directed to a product dispenser and a method of making the product dispenser. The present invention is also directed to a product dispenser in combination with one or more solid products. The present invention is further directed to product dispensing systems, which include a product dispenser in combination with one or more additional system components.

One exemplary product dispensing system of the present invention comprises (a) a product dispenser; (b) a product mix tank; (c) a dispenser conduit from the product dispenser into the product mix tank; and (d) a pump for transporting fluid from the product mix tank to the product dispenser. The product dispensing system of the present invention may further comprise one or more pieces of water-soluble solid product positioned within the product dispenser of the product dispensing system. When water contacts the solid product, the solid product dissolves to form a liquid use solution, which may be used in a number of applications.

The product dispenser within the product dispensing system may comprise a number of components. In one exemplary embodiment of the present invention, the product dispenser comprises one or more product spray nozzles positioned within the housing of the product dispenser. In this embodiment, fluid from the product mix tank is pumped into the product dispenser through the one or more product spray nozzles to contact solid product within the product dispenser.

The product mix tank within the product dispensing system may also comprise a number of components. In one exemplary embodiment of the present invention, the product dispenser comprises at least one water inlet, wherein at least one water inlet comprises one or more water fill nozzles positioned within an upper portion of the product mix tank. Other possible components within the product mix

tank include, but are not limited to, (i) at least one fluid level indicator, (ii) at least one monitoring device for monitoring at least one property of fluid within the product mix tank, (iii) at least one control device for controlling at least one component within the product mix tank, and (iv) at least one circulation nozzle positioned within the product mix tank, wherein at least a portion of the fluid from the product mix tank circulates through a pump and at least one circulation nozzle.

In a further exemplary embodiment of the present invention, the product dispensing system comprises a microprocessor for controlling and/or monitoring one or more controllable and/or monitorable parameters of the product dispensing system.

The present invention is further directed to a method of making a liquid solution using a product dispensing system. The method provides a liquid solution having a desired concentration of one or more active ingredients. One exemplary method of making a liquid solution using a product dispensing system of the present invention comprises (a) positioning a product dispensing system relative to a water source; (b) placing one or more pieces of solid product in a product dispenser of the product dispensing system; (c) filling a product mix tank of the product dispensing system with a desired amount of water; and (d) pumping water from the product mix tank into the product dispenser so that the water comes into contact with the one or more pieces of solid product to form the liquid use solution, which drains from the product dispenser into the product mix tank.

The method of making a liquid solution using a product dispensing system of the present invention may further comprise a number of step including, but not limited to, (e) circulating fluid within the product mix tank through a pump, a circulation valve, and one or more circulation nozzles positioned within the product mix tank; (f) controlling a fluid level within the product mix tank with one or more fluid level indicators; (g) monitoring at least one property of fluid within the product mix tank with a monitoring device; and (h) monitoring or controlling at least one parameter of the product dispensing system with a microprocessor.

The product dispensing system of the present invention may be used in a number of applications. One exemplary application comprises the product dispensing system of the present invention in

combination with a cooking apparatus, such as a rotary fryer (e.g., used to cook French fries), wherein liquid use solution from the product dispensing system is used to clean one or more components of the rotary fryer.

These and other features and advantages of the present invention will become apparent after a review of the following detailed description of the disclosed embodiments and the appended claims.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** depicts an exemplary product dispensing system of the present invention;

FIG. **2** depicts an exemplary product dispenser within an exemplary product dispensing system as shown in FIG. **1**;

FIGS. **3A-3D** depict a flowchart detailing an exemplary method of using a product dispensing system of the present invention; and

FIGS. **4A-4B** depict a flowchart detailing an exemplary method of using a product dispensing system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

To promote an understanding of the principles of the present invention, descriptions of specific embodiments of the invention follow and specific language is used to describe the specific embodiments. It will nevertheless be understood that no limitation of the scope of the invention is intended by the use of specific language. Alterations, further modifications, and such further applications of the principles of the present invention discussed are contemplated as would normally occur to one ordinarily skilled in the art to which the invention pertains.

The present invention relates to a product dispensing system for forming a liquid "use" solution from water and at least one solid product. As used herein, the terms "use solution" and "liquid use solution" refer to an aqueous solution resulting from the interaction of water and a solid product within a product dispenser of the present invention. The product dispensing systems of the present invention comprise a product dispenser in combination with one or more additional system components. Desired use solutions, such as

cleaning solutions, may be prepared using the product dispensing systems of the present invention as described below.

I. Product Dispensing Systems

The present invention is directed to product dispensing systems comprising a product dispenser, a solid product, and system components for converting the solid produced to a liquid "use" solution. In one exemplary embodiment of the present invention, the dispensing system comprises (i) a product dispenser comprising a housing having a cavity configured and arranged to receive a solid product, the housing having a bottom, a top, and at least one side defining the cavity; an inlet/outlet for water into and out of the housing; an optional support member positioned within the cavity, wherein at least a portion of the support member is positioned at a distance, *d*, above the outlet of the housing; and (ii) a solid product positioned on the support member. Desirably, the product dispenser housing is capable of withstanding at least about 30 psi of water and/or air pressure within the housing cavity.

In a further exemplary embodiment of the present invention, the dispensing system comprises (i) a product dispenser having a cavity, and (ii) a solid product, wherein the cavity and solid product have substantially similar cross-sectional configurations. In this embodiment, the solid product fits into the cavity in such a way that a user instantaneously knows how to input the solid product. Other features of product dispensers and suitable solid products for use in the present invention are described below.

An exemplary product dispensing system of the present invention is shown in FIG. **1**. As shown in FIG. **1**, product dispensing system **10** comprises product dispenser **11** attached to product mix tank **12** via dispenser conduit **36**. Exemplary product dispensing system **10** further comprises pump **13**, which transports fluid from within product mix tank **12** to one or more of the following locations: product dispenser **11**, circulation nozzles **16** within product mix tank **12**, and one or more vessels to be cleaned (not shown) via transfer valves **24**. Water is supplied to product mix tank **12** via hot water supply line **26** and cold water supply line **27**. As shown in FIG. **1**, regulators **44** and **45** may be positioned within hot water supply line

26 and cold water supply line **27**, respectively. Further, a tempering valve **28** may be used to form a desired mixture of hot and cold water. Water exiting tempering valve **28** through first water conduit **46** may pass through strainer **29** to remove any particulate material within the water supply. Water valve **30** may be used to control water flow into product mix tank **12**. A vacuum breaker, such as vacuum breaker **31**, may be positioned between water valve **30** and product mix tank **12** along second water conduit **32** in order to provide exposure to atmospheric pressure once pressure within second water conduit **32** falls below a pressure threshold. Typically, the pressure threshold is about 5 to 15 psi.

Water enters into product mix tank **12** via one or more water fill nozzles **25** positioned within an upper surface **47** of product mix tank **12**. As shown in FIG. **1**, fluid exiting product dispenser **11** through dispenser conduit **36** also enters product mix tank **12** through opening **37** within upper surface **47** of product mix tank **12**. Further, as shown in FIG. **1**, recirculated fluid may enter into product mix tank **12** through side wall inlet **38**.

Exemplary product mix tank **12** contains low level float indicator **17**, high level float indicator **18**, overflow outlet **19**, drain outlet **20**, and pump outlet **42**. A drain valve, such as drain valve **21**, may be positioned within drain conduit **43** to manually and/or automatically drain product mix tank **12**, as well as, capture fluid exiting overflow outlet **19**. Also shown within product mix tank **12** is fluid monitoring device **22**, which may be used to measure a property of a fluid within product mix tank **12**. In one exemplary embodiment of the present invention, fluid monitoring device **22** may be used to detect the concentration of a given active ingredient within a liquid solution positioned within product mix tank **12**.

One desirable feature of exemplary product dispensing system **10** is the ability to circulate liquid within product mix tank **12**. As shown in FIG. **1**, fluid may be removed from product mix tank **12** through pump outlet **42** and transported via pump **13** through pump conduit **39**, recirculation conduit **40**, circulation valve **15**, circulation nozzle conduit **41**, and circulation nozzles **16** to be deposited back into product mix tank **12**. Another desirable feature of exemplary product dispensing system **10** is the ability to spray solid product (not shown)

positioned within product dispenser **11** with liquid from product mix tank **12**. As shown in FIG. **1**, liquid may be removed from product mix tank **12** via pump outlet **42** and transported through pump **13**, pump conduit **39**, recirculation conduit **40**, product spray valve **14**, spray conduit **33**, into product dispenser **11** via product dispenser inlet **34** within a bottom surface **48** of product dispenser **11**. Liquid may be allowed to come into contact with solid product positioned within product dispenser **11** as detailed in FIG. **2** below. Liquid containing dissolved solid product exits product dispenser **11** through product dispenser outlet **35** into dispenser conduit **36**, which is deposited within product mix tank **12** through opening **37** within upper surface **47** of product mix tank **12**.

The above-described product dispensing system **10** of the present invention may comprise a number of components as shown in FIG. **1**. Each individual component of product dispensing system **10** may be formed from conventional materials used to form conduit, mixing tanks, etc. Each individual component of product dispensing system **10** may be formed from any material having structural integrity and being capable of contacting water and/or solid product. For components that come into contact with only water, suitable materials for forming the components include, but are not limited to, plastics, glass, ceramics, metal, or any combination thereof. Typically, components that come into contact with only water are formed from metals such as copper or plastics such as polyvinyl chloride (PVC) or chlorinated polyvinyl chloride (CPVC). For components that come into contact with water, solid product, and liquid use solution resulting from the combination of water and solid product, the components are desirably formed from materials including, but not limited to, plastics, glass, ceramics, metal, or any combination thereof. Typically, these components are formed from a non-reactive, non-corrosive metal, such as stainless steel, or an unreactive plastic, such as PTFE (TEFLON®) or PVDF (KYNAR®).

In preferred embodiments of the present invention, the product dispensing system further comprises a programmable logic controller or microprocessor that provides process control features to the product dispensing system. For example, any of the above-mentioned valves may be opened or closed using a microprocessor, as well as, opened

for a desired length of time, which may be monitored by the microprocessor. In addition to fluid monitoring device **22**, sensors may be positioned throughout product dispensing system **10** to provide feedback to the microprocessor. Suitable sensors include, but are not limited to, liquid level sensors connected to or separate from low level float indicator **17** and high level float indicator **18**, pressure gauges located throughout product dispensing system **10**, temperature gauges distributed throughout product dispensing system **10**, and a solid product detection sensor that detects when additional solid product needs to be added to product dispenser **11**.

A variety of programmable logic controllers or microprocessors may be used within the product dispensing system of the present invention. Suitable microprocessors include, but are not limited to, the fanuc Versa Max microprogrammable logic controller available from General Electric Company (Fairfield, CT).

The product dispensing system of the present invention is desirably connected to an electricity source such as 120 volt AC 15 amp receptacle. Further, the product dispensing system of the present invention desirably is connected to both a cold and hot water supply having a minimum water pressure for each supply line of at least about 30 pounds per square inch (psi) and a maximum water pressure of about 70 psi.

The overall dimensions of the product dispensing system of the present invention may vary depending on the given application. In one exemplary embodiment of the present invention, the product dispensing system is used in combination with a rotary fryer for cooking French fries. In this embodiment, the overall dimensions of the product dispensing system may be as follows: height - about 114.3 cm (45 in.); width - about 50.8 cm (20 in.); and depth - about 48.3 cm (19 in.).

The product dispensing system may be positioned relative to a water source for supplying water to the product dispensing system and one or more containers or vessels for receiving the liquid use solution exiting the product dispensing system (e.g., a cooking apparatus).

The above-described product dispensing system **10** may be used in a variety of applications where a liquid use solution is desired. Typically, the product dispensing system is positioned at a location

within a residential, commercial or industrial property for easy access for a user. One or more pieces of solid product are positioned within the product dispenser and replaced as needed. In some applications, the solid product is used for a single batch operation. In other applications, solid product is used on more of a continuous basis, such that additional solid product is placed into the product dispenser on a regular basis.

A. Product Dispenser

A variety of product dispensers may be used in the above-described product dispensing system of the present invention. The product dispenser enables the interaction of water with one or more water-dissolvable solid products. The product dispenser may have any configuration, shape and size, which enable water to come into contact with the one or more water-dissolvable solid products. Although reference may be made to a particular size and shape, it should be understood that the product dispenser of the present invention is not limited in any way to a particular design, size or shape.

The product dispenser typically comprises a number of components. In one embodiment, the product dispenser of the present invention comprises (i) a housing having a cavity configured and arranged to receive a solid product, wherein the housing has a bottom, a top, and at least one side defining the cavity; (ii) an inlet for inputting water into the housing; (iii) an outlet on the bottom of the housing in addition to the inlet; and (iv) an optional support member positioned within the cavity, wherein at least a portion of the support member is positioned at a distance, *d*, above the outlet of the housing. Each component of the product dispenser provides a given function so as to produce a desired use solution having a desired concentration of solid product therein.

The product dispenser may include a solid product support member positioned within the cavity of the housing. The support member may have a solid continuous structure, such as a metal foil or plastic film, or may have a discontinuous, permeable structure, such as a mesh or screen formed from materials including, but not limited to, metals, plastics, and combinations thereof. In one embodiment of the present invention, the support member comprises a continuous

structure in a horizontal plane within the cavity of the product dispenser, wherein the upper surface area of the support member is less than the surface area of the horizontal plane such that water may flow through the horizontal plane from below the continuous structure to contact the water-dispersible product positioned on the continuous structure. It should be noted that the support member may have a configuration other than one, which is within a single horizontal plane within a cavity of the product dispenser. For example, the support member may have a V-shape, U-shape, W-shape or any other configuration as long as the support member is capable of supporting a water-dispersible product within the product dispenser.

In a further embodiment of the present invention, the support member comprises a permeable structure in a horizontal plane within the cavity of the product dispenser, wherein the upper surface area of the support member is less than or equal to the surface area of the horizontal plane such that water may flow through and/or around the support member from below the permeable structure to contact the water-dispersible product positioned on the support member. As discussed above, the permeable support member may have a configuration other than one, which is within a single horizontal plane within a cavity of the product dispenser. For example, the permeable support member may have any of the configurations described above (i.e., V-shape, U-shape, W-shape, or other shape).

A portion of the support member may be positioned at a distance, d, above the outlet of the housing. For support members having a V-shape, U-shape, or W-shape as described above, the lower portion of the support member may actually rest on an upper surface of the outlet of the housing. In other embodiments, the lower portion of the support member having a V-shape, U-shape, or W-shape may be at a distance, d, above the outlet of the housing, while an upper portion of the support member is positioned at a distance, $(d + t)$, above the outlet of the housing, wherein t represents the overall thickness of the support member.

The product dispenser further comprises one or more openings to allow access to the housing so that solid product may be positioned in the housing. Each opening may be sealed with an attachable cover to seal the housing after loading the product dispenser with solid

product. Typically, the product dispenser has a single opening and attachable cover for providing access to the product dispenser cavity. Each of the one or more covers may be separable from and removable from the product dispenser or may be attached to the product dispenser using any conventional method of attaching. In one embodiment, a hinge is used to attach a cover to the product dispenser, so that the cover may be removed and reconnected to the product dispenser without being detached from the product dispenser.

The product dispenser may be formed from any material having structural integrity and being unreactive to water and solid product. Suitable materials for forming the product dispenser include, but are not limited to, plastics, glass, ceramics, metal or any combination thereof. Desirably, the product dispenser comprises a clear or transparent plastic cover material, which allows a visual inspection of any solid product in the cavity. In one embodiment of the present invention, at least a portion of the product dispenser comprises a transparent material to allow a visual inspection of one or more portions of the product dispenser, desirably, at least the interior of the cavity and any solid product therein. As described below, the product dispenser is desirably formed from a material that can withstand up to about 30 psi of water pressure exerted on the cavity surfaces of the product dispenser.

An exemplary product dispenser is shown in FIG. **2**. As shown in FIG. **2**, exemplary product dispenser **11** includes housing cavity **49** surrounded by upper surface **54**, at least one side wall **53**, and bottom surface **48**. As shown in FIG. **2**, support member **50** supports solid product **52** positioned within cavity **49** of product dispenser **11**. Product dispenser **11** may further comprise one or more product spray nozzles **51** positioned below support member **50**, when present.

As shown in FIG. **2**, water enters product dispenser **11** through product dispenser inlet **34** via spray conduit **33**. Once inside product dispenser **11**, water flows through spray nozzle conduit **56** to one or more product spray nozzles **51**. Water exiting product spray nozzle **51** comes into contact with water-soluble solid product **52** and produces a liquid use solution, which exits product dispenser **11** through product dispenser outlet **35** and dispenser conduit **36**.

As discussed above, product dispenser **11** may have a size and shape so that the product dispenser matches a given water source and/or a container or vessel for receiving the use solution. In one exemplary embodiment of the present invention, the product dispenser has a circular shape; however, it should be understood that other shapes are within the scope of the present invention. Suitable shapes include, but are not limited to, a rectangular shape, a square shape, a triangular shape, a star shape, an arrow shape, a rhombus shape, a trapezoid shape, etc. Desirably, the product dispenser has dimensions as follows: an overall height ranging from about 7.6 cm (3.0 inches) to about 45.7 cm (18.0 inches); an overall length ranging from about 15.2 cm (6.0 inches) to about 61.0 cm (24.0 inches); an overall width ranging from about 5.1 cm (2.0 inches) to about 30.5 cm (12.0 inches); and a height of at least a portion of product support member **50** above product dispenser outlet **35** ranging from greater than 0 to about 40.6 cm (16.0 inches).

In one embodiment of the present invention, the product dispenser comprises a cavity, wherein the cavity has a cross-sectional configuration, which matches a cross-sectional configuration of the solid product to be used in the product dispenser. In this embodiment, the solid product fits into the cavity of the product dispenser in such a way that a user cannot incorrectly input the solid product into the cavity of the product dispenser without altering the configuration of the solid product. Suitable cavity/solid product cross-sectional configurations for use in this embodiment of the present invention include, but are not limited to, a star-like cross-sectional configuration, an arrow cross-sectional configuration, and a diamond cross-sectional configuration.

An exemplary product dispenser/solid product system, wherein the cavity of the product dispenser and the solid product have a similar cross-sectional configuration, is described in U.S. Patent Application Serial No. 10/139,612 filed on May 02, 2002, and entitled "Product Dispenser," the subject matter of which is hereby incorporated herein in its entirety by reference.

When solid product is placed in the product dispenser, it is desirable for the solid product to have a total volume equal to or less than a cavity volume bordered by the top of the housing, the support

member, and at least one side of the housing. One or more pieces of solid product may be used to fill the cavity volume. Desirably, the one or more pieces of solid product may be stacked one on top of the other to fill the cavity volume, and also provide a consistent surface area of solid product within a horizontal plane of solid product as one moves along a vertical direction within the product dispenser cavity. Such a configuration enables a consistent dispersion of solid product into the water, which contacts the solid product.

As discussed above, the product dispenser may have any dimensions necessary for a given application. For more continuous applications wherein an amount of solid product is used on a continuous basis, the dimensions of the product dispenser may be selected such that the cavity has relatively small cross-sectional dimensions when compared to the height of the cavity. In this embodiment, numerous solid products may be stacked on top of one another.

The product dispensers and product dispensing systems of the present invention accurately dispense cleaning, rinse, and/or sanitizing products. The product dispensers are ideal for use in combination with cooking apparatus to provide cleaning solutions during a cleaning mode, but many other applications are also possible. Other uses and applications where dispensing of a solid product is desired are also possible with the present invention, and the product dispensers disclosed herein could be used with a variety of containers or other use solution receiving devices.

B. Solid Product

A variety of solid products may be used in the above-described product dispensers. The solid products comprise one or more water-dissolvable components, which are formed into a desired shape having a desired size. The solid products may have any shape or size suitable for use in the product dispensers. For example, the solid products may be in the form of pellets, beads or powders having a size such that hundreds of pieces of solid product fill a given product dispenser. The pellets, beads or powders may be shaped into larger pieces of solid product such that only one or a dozen pieces of solid product fit within a given product dispenser. Typically, the solid products have a

circular, rectangular, square, triangular, arrow-like, rod-like, or star-like shape as described above. Desirably, the solid products have a circular, rectangular, square, or arrow-like shape.

In one desired embodiment of the present invention, the solid product has a size, which enables one or more pieces of solid product to be placed within the cavity of the product dispenser, wherein each piece of solid product has a configuration, which increases the surface area of the piece of solid product. For example, a solid product may have a rectangular or square shape, and also have one or more holes through the rectangular or square shape in a direction parallel or perpendicular to a horizontal axis of the solid product. Other solid product configurations may include fins or slots within the product to increase the surface area of the product. Suitable solid product configurations for use in the present invention include, but are not limited to, solid product configurations disclosed in U.S. Patent Application Serial No. 10/139,612 filed on May 02, 2002, and entitled "Product Dispenser," the subject matter of which is hereby incorporated herein in its entirety by reference.

The solid products may comprise one or more water-dissolvable components. Suitable water-dissolvable components include, but are not limited to, components selected from caustic cleaning compositions, rinse aids, detergents, surfactants, sanitizers, pest control agents, or a combination thereof. Suitable solid products include, but are not limited to, products disclosed in U.S. Patent Application Serial No. 09/282,001, filed on March 29, 1999 entitled "SOLID POT AND PAN DETERGENT" and assigned to Ecolab Inc. (St. Paul, MN), the entire contents of which are herein incorporated by reference. Desirably, the solid product comprises a caustic cleaning composition, such as caustic cleaning compositions available from Ecolab Inc. (St. Paul, MN).

Solid products having an increased surface area may be formed from any of the water-dissolvable components described above. In addition, solid products having an increased surface area may be formed from commercially available solid products including, but not limited to, the MAGFUSION Product from Ecolab Inc. (St. Paul, MN).

II. Methods of Making a Liquid Use Solution

The present invention is further directed to a method of making a liquid use solution. The method may comprise: (i) positioning a product dispensing system, a water source, and a container (or other receiving device) relative to one another; (ii) placing one or more pieces of solid product within a product dispenser of the product dispensing system; (iii) causing water to enter into the product dispenser such that the water comes into contact with the solid product for a desired contact time to form a use solution; optionally, (iv) collecting the use solution that exits the product dispenser for storage; and (v) transporting the use solution to a receiving vessel.

The method may produce a use solution for use in a variety of containers or other receiving devices. Suitable receiving devices for use in the present invention include, but are not limited to, a cooking apparatus, a warewashing apparatus, a sink, a bucket, a laundry machine, a sauna, a carwashing apparatus component (i.e., a holding tank for storing car washing solution), or a pool. In one desired embodiment of the present invention, the method produces a cleaning solution and the receiving device is a cooking apparatus, such as a rotary fryer.

One exemplary method of the present invention may be further described with reference to FIGS. **3A-3D**. The exemplary method **150** depicted in FIGS. **3A-3D** begins at start block **100** and proceeds to decision block **101**. At decision block **101**, a decision is made whether or not to add solid product to the product dispenser. If a decision is made to add solid product to the product dispenser, the method proceeds to step **102** wherein the product dispenser is opened. The method then proceeds to step **103** in which one or more solid product pieces are placed into the product dispenser. At step **104**, the product dispenser is sealed to prevent contamination of the solid product. The method then proceeds to step **105**.

Returning to decision block **101**, if a decision is made not to add solid product to the product dispenser, the method proceeds directly to step **105** wherein water is introduced into the product mix tank **12**. The method then proceeds to decision block **106** wherein a determination is made as to whether a desired water level has been reached within product mix tank **12**. If a determination is made at

decision block **106** that the desired water level has not been reached, the method returns to step **105** as described above. If a determination is made that a desired water level has been reached at decision block **106**, the method proceeds to step **107** wherein the water supply to product mix tank **12** is stopped. The method then proceeds to step **108** wherein pump **13** is activated. From step **108**, the method proceeds to step **109** wherein product spray valve **14** is opened to enable water to flow into product dispenser **11**.

Method **150** proceeds to decision block **110** wherein a determination is made as to whether the current process is a flush cycle. If a determination is made that the current process is not a flush cycle, the method proceeds to decision block **111**. At decision block **111**, a determination is made as to whether the desired product concentration of the liquid use solution within product mix tank **12** has been reached. If a determination is made at decision block **111** that the desired product concentration of the liquid use solution has not been reached, the method proceeds to step **112**. At step **112**, circulation valve **15** is opened for a fixed time period, t_1. The method then proceeds to step **113** wherein circulation valve **15** is closed for a fixed period of time, t_2. The method then proceeds to step **114** wherein the method returns to decision block **111**. Method steps **112** through **114** are repeated until the product concentration of the liquid use solution within product mix tank **12** is reached. It should be noted that during steps **112** through **114**, pump **13** and product spray valve **14** remain activated, which results in additional solid product being added to the liquid use solution within product mix tank **12**. Although fixed time periods t_1 and t_2 may vary for a given application, fixed time periods t_1 and t_2 typically range from 5 to 60 seconds, desirably, from about 25 to about 35 seconds.

The length of time required to reach a desired product concentration within the liquid use solution may vary depending on a number of factors including, but not limited to, the water temperature, the solid product composition, the water solubility of the solid product, and the desired concentration level. Typically, the length of time necessary to reach a given concentration level will be up to about 30 minutes. In one exemplary embodiment of the present invention, the length of time needed to reach a concentration level of 8% by

weight solids within a 3.5 gallon liquid use solution is about 15 minutes.

Returning to decision block **111**, once the product concentration level has been reached, the method proceeds to step **115** wherein product spray valve **14** is closed. The method then proceeds to step **116** wherein pump **13** is deactivated. From step **116**, the method proceeds to step **117** wherein circulation valve **15** is closed. At this point, the liquid use solution within product mix tank **12** may be mixed for a desired period of time or immediately transferred to a receiving vessel. From step **117**, the method proceeds to step **118** wherein one or more transfer valves **24** is opened. The method then proceeds to step **119** wherein pump **13** is again activated to transport liquid use solution from product mix tank **12** to a receiving vessel via one or more transfer valves **24**.

From step **119**, the method proceeds to decision block **120** wherein a determination is made as to whether the liquid use solution level within product mix tank **12** has dropped to a desired level. If a determination is made that the liquid use solution level has not dropped to a desired level, the method proceeds to step **121** wherein liquid use solution continues to be transferred to a receiving vessel. From step **121**, the method proceeds to step **122** wherein the method returns to decision block **120**. Once the liquid use solution level within product mix tank **12** drops to a desired level, the method proceeds to step **123** wherein pump **13** is deactivated. The method then proceeds to step **124** wherein one or more transfer valves are closed. The method then proceeds to decision block **125**.

At decision block **125**, a decision is made whether or not to drain the product mix tank **12**. If a decision is made to drain product mix tank **12**, the method proceeds to step **126** wherein drain valve **21** is opened. The method then proceeds to step **127** wherein drain valve **21** is closed once product mix tank **12** is empty. The method then proceeds to decision block **128**.

Returning to decision block **125**, if a decision is made not to drain the product mix tank, the method proceeds directly to decision block **128**. At decision block **128**, a decision is made whether or not to flush the product dispensing system. If a decision is made not to flush the product dispensing system at decision block **128**, the method

proceeds to stop block **129**. If a decision is made to flush the product dispensing system, the method proceeds to step **130** wherein solid product is removed from the product dispenser. The process of removing solid product from product dispenser **11** comprises opening product dispenser **11**, removing solid product **52** from product dispenser **11**, and sealing product dispenser **11**. From step **130**, the method proceeds to step **131**, which returns method **150** to step **105**. At step **105**, the flush cycle portion of the method proceeds from step **105** to decision block **110** as described above. At decision block **110**, a determination is made that the present process cycle is a flush cycle, and method **150** proceeds to step **132**. At step **132**, pump **13** is activated and runs for a fixed time period t_3, wherein t_3 is desirably greater than t_1 plus t_2. The method then proceeds to step **133** wherein circulation valve **15** is opened for a fixed time period, t_1. The method then proceeds to step **134** wherein circulation valve **15** is closed for a fixed period of time, t_2. The method then proceeds to decision block **135**.

At decision block **135**, a determination is made as to whether time period t_3 has expired. If a determination is made that time period t_3 has not expired, the method returns to step **133** and proceeds as described above. Once time period t_3 has expired, the method proceeds to step **136** wherein product spray valve **14** is closed. The method then proceeds to step **137** wherein pump **13** is deactivated. The method then proceeds to step **138** wherein circulation valve **15** is closed. The method then proceeds to step **139** wherein drain valve **21** is opened to drain product mix tank **12**. The method then proceeds to step **140** wherein drain valve **21** is closed once product mix tank **12** is empty.

From step **140**, the method proceeds to decision block **141**. At decision block **141**, a decision is made whether or not to repeat the flush cycle. If a decision is made to repeat the above-described flush cycle, the method proceeds to step **142** wherein the method proceeds to step **105** and proceeds as outlined above. If a decision is made not to repeat the above-described flush cycle at decision block **141**, the method proceeds to stop block **143**.

The method of the present invention may be used to prepare a use solution having a desired concentration of solid product within an

aqueous solution. A number of variable may be considered to obtain a desired use solution concentration including, but not limited to, the contact time between the water and the solid product, the water temperature, the dissolving rate of the solid product, the chemical formulation of the solid product, the shape of the solid product, the amount of surface area of the solid product, and the water flow rate into and out of the product dispenser. By adjusting one or more of the above variables, a use solution concentration may be obtained within a desired length of time.

As discussed above, the process dispensing system of the present invention may comprise a programmable logic controller or microprocessor to provide one or more process control features to the product dispensing system. Variables such as fixed time periods t_1, t_2, and t_3, may be inputted into the microprocessor and monitored to automatically open and/or close valves within the product dispensing system. Further, historical information such as the length of time needed to drain product mix tank **12**, may be inputted into the microprocessor to further control the length of time that drain valve **21** remains opened. As described above, many other process variables may be monitored using process control equipment including, but not limited to, fluid pressure within individual components of the product dispensing system, the temperature of equipment and/or liquid within the product dispensing system, as well as, system malfunctions within the product dispensing system.

An exemplary process control flow chart for a product dispensing system of the present invention is provided in FIGS. **4A-4B**. As shown in FIG. **4A**, method **200** begins at start block **201**. Method **200** proceeds to step **202** wherein one or more process control set points are checked for one or more variables such as water level, product concentration level, and product transfer completion status. It should be noted that exemplary method **200** describes process control parameters water level, product concentration level, and transfer completion status; however, any other process control variable may also be monitored in a similar manner as described in exemplary method **200**. From step **201**, the method proceeds to decision block **203**. At decision block **203**, a determination is made as to whether the water level set point has been reached. If a determination is made that

the water level set point within product mix tank **12** has not been reached, the method proceeds to steps **204A** and **204B**. In step **204A**, a microprocessor activates water valve **30** to begin filling product mix tank **12**. At the same time, in step **204B** an electronic water fill time-out clock is started. In this embodiment, a time limit is placed on the process of filling product mix tank **12**. If product mix tank **12** is not filled to a desired level within the designated amount of time, an alarm is triggered as described below.

From steps **204A** and **204B**, method **200** proceeds to step **205** wherein a fresh water fill cycle is initiated. The method then proceeds to decision block **206** wherein a determination is made whether or not both level float indicators (i.e., low level float indicator **17** and high level float indicator **18**) are open (i.e., the water level within product mix tank **12** has not exceeded the level as determined by low level float indicator **17**). If a determination is made that both level floats are open, method **200** proceeds to decision block **207**. At decision block **207**, a determination is made whether or not the time designated to fill product mix tank **12** has been exceeded. If a determination is made that the "water fill time-out" has not been exceeded, the method returns to step **205** as described above. Method **200** proceeds to step **206**, step **207**, and step **205** until both floats are not in an "open" position (i.e., the water level has exceeded a level as determined by low level float indicator **17**). Once one float is not open, method **200** proceeds from decision block **206** to decision block **208**.

At decision block **208**, a determination is made as to whether the low level float indicator **17** is closed and the high level float indicator **18** is open. If a determination is made that low level float indicator **17** is closed and high level float indicator **18** is open, method **200** proceeds from decision block **208** to decision block **207** as described above. The method will proceed from decision block **208** to decision block **207** to step **205** and back to decision block **208** until high level float indicator **18** is not opened. At that time, method **200** proceeds to decision block **209**.

At decision block **209**, a determination is made as to whether or not both low level float indicator **17** and high level float indicator **18** are in a closed position. If a determination is made that both float indicators are not in a closed position, method **200** proceeds to

decision block **207** as described above. At decision block **207**, if a determination is made that the water fill time-out limit has been exceeded, the method proceeds to step **210** wherein a level-sensing malfunction alarm is triggered.

Returning to decision block **209**, if a determination is made that both the low level float indicator **17** and the high level float indicator **18** are in a closed position, method **200** proceeds to step **211** wherein the water fill status is set to a "completed" mode. Method **200** then proceeds to step **212**, which transfers method **200** to decision block **213**.

At decision block **213**, a determination is made as to whether or not the concentration level of solid product within the liquid use solution has been reached. If a determination is made that the concentration level of solid product within liquid use solution has not been reached, method **200** proceeds to step **214**. In step **214**, the microprocessor opens spray valve **14** and activates pump **13**. The method then proceeds to step **215** wherein a "charge-up cycle" is initiated. As used herein, the term "charge-up cycle," refers to the process of exposing solid product **52** to water in order to increase the concentration of solid product within the liquid use solution as described in steps **108** through **117** of process **150** depicted in FIGS. **3A-3D**. From step **215** (as shown in FIG. **4B**), method **200** proceeds to decision block **216** wherein a determination is made as to whether the concentration level of solid product within the liquid use solution has reached a set point. If a determination is made by the microprocessor that the concentration level of solid product within the liquid use solution has not reached a set point, method **200** proceeds to decision block **217**.

At decision block **217**, a determination is made as to whether the microprocessor has detected the absence of solid product **52** within product dispenser **11**. If a determination is made that the product dispenser **11** is empty or needs additional solid product **52**, method **200** proceeds to step **218** wherein an empty alarm output is initiated by the microprocessor. If a determination is made at decision block **217** that product dispenser **11** is not empty (or does not need additional solid product **52**), method **200** returns to step **215** as described above. Once a determination is made at decision block **216** that the

concentration level of solid product within the liquid use solution has reached a set point, method **200** proceeds to step **219**. At step **219**, the microprocessor provides a "ready to transfer" output to indicate that the liquid use solution is ready to be transferred to a receiving vessel. Method **200** then proceeds to step **220** wherein the microprocessor waits for a transfer request. The method then proceeds to step **221**, which transfers method **200** to step **222**.

At step **222**, the microprocessor waits for a transfer request signal. Method **200** then proceeds to decision block **223** wherein a determination is made as to whether or not a transfer request has been received. If a transfer request has not been received by the microprocessor, method **200** returns to step **222**. Once a transfer request is received by the microprocessor, method **200** proceeds to steps **224A** and **224B**. In step **224A**, the microprocessor sends a signal to open at least one transfer valve **24** and activate pump **13**. At the same time, a transfer time-out clock is started in step **224B**. The transfer time-out clock counts down a programmed amount of time that it typically takes to transfer a batch of liquid use solution from product mix tank **12** to a receiving vessel. If the actual transfer cycle exceeds the programmed amount of time counted off by the transfer time-out clock, a transfer time out error occurs as discussed below.

From steps **224A** and **224B**, method **200** proceeds to step **225** wherein a transfer cycle is initiated. As used herein, the term "transfer cycle," refers to the steps relating to transferring a liquid use solution from product mix tank **12** to a receiving vessel. An example of such steps may be found in FIGS. **3A-3D**, steps **118** to **124**. From step **225**, method **200** proceeds to decision block **226** wherein a determination is made as to whether or not low level float indicator **17** is "active." As used herein, the term "active" refers to a signal sent to the microprocessor when low level float indicator **17** is in a down position. If a determination is made that low level float indicator **17** is not active, method **200** proceeds to decision block **227**. At decision block **227**, a determination is made as to whether the transfer clock time-out has exceeded a set programmed length of time. If a determination is made that the transfer clock has not exceeded a set programmed period of time, method **200** returns to step **225** and proceeds as described above. If a determination is made at decision

block **227** that the transfer clock has exceeded the set programmed period of time, method **200** proceeds to step **228** wherein the microprocessor generates a transfer time-out error output signal.

Returning to decision block **226**, if a determination is made that the low level float indicator **17** is in an active position (i.e., a signal is sent to the microprocessor indicating that low level float indicator **17** is in a down position), method **200** proceeds to step **229** wherein the microprocessor generates a transfer complete output signal. Method **200** then proceeds to stop block **230**.

In one embodiment of the present invention, the method of making a use solution comprises producing a use solution, which is dispersed in a cooking apparatus, a warewashing apparatus, a sink, a bucket, a laundry machine, a sauna, a carwashing apparatus component (i.e., a holding tank for storing car washing solution), a pool, or any other container. When used with a cooking apparatus, the product dispensing system may be mounted proximate a water source either outside of or within the cooking apparatus.

In a further embodiment of the present invention, the method of making a use solution comprises producing a use solution for a rotary fryer, such as a rotary fryer used to produce French fries for fast-food restaurants, such as McDonald's restaurant.

The present invention is further illustrated by the following examples, which are not to be construed in any way as imposing limitations upon the scope thereof. On the contrary, it is to be clearly understood that resort may be had to various other embodiments, modifications, and equivalents thereof which, after reading the description herein, may suggest themselves to those skilled in the art without departing from the spirit of the present invention and/or the scope of the appended claims.

While the specification has been described in detail with respect to specific embodiments thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, the scope of the present invention should be assessed as that of the appended claims and any equivalents thereto.